

1 Claims

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3 1. A method of producing thermoplastic hydrogels for use
4 in producing contact lenses, comprising the step of
5 reacting one or more from the list;
6 polyethylene oxide,
7 polyol,
8 polyamine,
9 with a polyisocyanate and a polyfunctional amine or
10 polyalcohol.

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12 2. A method of producing thermoplastic hydrogels for use
13 in producing contact lenses, comprising the step of
14 reacting one or more from the list
15 polyethylene oxide
16 polyol
17 polyamine
18 and a polyisocyanate that is prepared using a range of
19 NCO:OH or NCO:NH₂ ratios.

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21 3. A method of producing thermoplastic hydrogels as in
22 Claims 1 or 2 wherein the polyol is polyethylene
23 glycol.

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25 4. A method of producing thermoplastic hydrogels as in any
26 of the previous Claims wherein the method also
27 comprises the step of end capping unreacted groups with
28 a unit capable of producing hydrogen bonding, π
29 bonding, ionic bonding, hydrophobic bonding and/or
30 phase separation or forming a glassy or crystalline
31 phase separated domain.

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- 1 5. A method of producing thermoplastic hydrogels as in
- 2 Claims 1 - 3 wherein the method also comprises the step
- 3 of end capping unreacted groups with a unit from a list
- 4 of:
 - 5 Mono-functional amine
 - 6 Mono-functional isocyanate
 - 7 Mono-functional anhydride
 - 8 Mono-functional acid
 - 9 A cyclic diacid anhydride
 - 10 Mono-functional alcohol
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- 12 6. A method of producing thermoplastic hydrogels as in any
- 13 of the previous Claims wherein a biodegradable unit may
- 14 be incorporated.
- 15
- 16 7. A method of producing thermoplastic hydrogels as in
- 17 Claim 6 wherein biodegradable unit may be
- 18 polycaprolactone, poly (lactic acid), poly(glycolic)
- 19 acid or poly(hydroxybutyric) acid, amine or hydroxyl
- 20 ended poly(amino) acids (protein or peptide analogues).
- 21
- 22 8. A method of producing thermoplastic hydrogels as in any
- 23 of the previous Claims wherein the ratios of the
- 24 components are selected such that, at complete
- 25 reaction, the product does not form a macrogel.
- 26
- 27 9. A method of producing thermoplastic hydrogels as in any
- 28 of the previous Claims wherein the reaction is prepared
- 29 using a range of NCO:OH or NCO:NH₂ ratios from 2:1 to
- 30 1:2.
- 31
- 32 10. A method of producing thermoplastic hydrogels as in
- 33 any of the previous Claims wherein where both OH and

1 NH₂ groups are used within the single reaction, a range
2 of NCO:(OH+NH₂) ratios of 2:1 to 1:2.

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4 11. A method of producing thermoplastic hydrogels as in
5 any of the previous Claims wherein the first step
6 reaction is prepared using NCO:OH or NCO:NH₂ ratios of
7 2.0:1 to 1:1.8 and 1.8:1 to 1:1.8.

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9 12. A method of producing thermoplastic hydrogels as in
10 any of the previous Claims wherein the range of ratios
11 used may be extended by the addition of monofunctional
12 amines, alcohols or cyanates.

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14 13. A method of producing thermoplastic hydrogels as in
15 any of the previous Claims wherein a macrogel is
16 prevented from forming by stopping the reaction before
17 completion.

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19 14. A method of producing thermoplastic hydrogels as in
20 Claim 13 wherein the reaction is stopped by the
21 addition of a monoamine, an amine terminated polymer, a
22 mono-alcohol or an alcohol terminated polymer.

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24 15. A method of producing thermoplastic hydrogels as in
25 Claim 14 wherein the monoamine, mono-alcohol, amine
26 terminated polymer or alcohol terminated polymer is
27 added when the reaction is partially complete.

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29 16. A method of producing thermoplastic hydrogels as in
30 Claims 1-12 wherein an amine or alcohol is admixed at
31 the outset thus removing the possibility of gelation.

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1 17. A method of producing thermoplastic hydrogels as in
2 Claim 16 wherein the amine is added in the form of
3 amine carbonate.

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5 18. A method of producing thermoplastic hydrogels as any
6 of the previous Claims wherein products with NCO end
7 groups are subjected to a final curing by immersion in
8 liquid water or steam after moulding.

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10 19. A method of producing thermoplastic hydrogels as in
11 any of the previous Claims wherein, after the initial
12 reaction, a second stage occurs, and in the second
13 stage the unreacted groups are capped with an amine.

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15 20. A method of producing thermoplastic hydrogels as in
16 Claim 19 wherein unreacted NCO groups are endcapped.

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18 21. A method of producing thermoplastic hydrogels as in
19 Claim 19 wherein unreacted OH groups are endcapped.

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21 22. A method of producing thermoplastic hydrogels as in
22 Claims 19 and 20 wherein terminal NCO groups are
23 converted into a strongly hydrogen bonding urea group.

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25 23. A method of producing thermoplastic hydrogels as in
26 Claims 19-22 wherein the unreacted groups are capped
27 with an aliphatic amine.

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29 24. A method of producing thermoplastic hydrogels as in
30 Claim 23 wherein the amine group is attached to a long
31 linear or branched alkyl group or to an aryl- or
32 aralkyl-amine.

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1 25. A method of producing thermoplastic hydrogels as in
2 Claim 23 wherein the amine group is attached to
3 polymers or low molecular weight pre-polymers.

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5 26. A method of producing thermoplastic hydrogels as in
6 Claims 19 and 21 wherein, excess OH groups are capped
7 with one or more molecules from the list of;
8 mono-isocyanate ended aromatic molecules,
9 mono-acid anhydride ended aromatic molecules,
10 mono-isocyanate ended aliphatic molecules,
11 mono-acid anhydride ended aliphatic molecules
12 reaction product of a monoamine with a di(or higher)
13 isocyanate.

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15 27. A method of producing thermoplastic hydrogels as in
16 Claims 19-26 wherein the groups used in the endcapping
17 process allow the polymers to interact with physical or
18 chemical cross-linking.

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20 28. A thermoplastic hydrogel for use in producing
21 contact lenses, prosthetic lenses or cosmetic lenses
22 produced by the methods described in Claims 1-27.

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24 29. A thermoplastic hydrogel as in Claim 28 wherein the
25 hydrogel is completely polymerised under the specific
26 conditions that are being used.

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28 30. A thermoplastic hydrogel as in Claims 28 and 29
29 wherein after polymerisation the hydrogel is heated.

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31 31. A thermoplastic hydrogel as in Claims 28 and 29
32 wherein after polymerisation the hydrogel is immersed
33 in water liquid or vapour.

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2 32. A thermoplastic hydrogel as in Claims 28 - 31
3 wherein the hydrogel may be pelletised, pressed,
4 extruded or heat, pressure, injection or compression
5 moulded.

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7 33. A thermoplastic hydrogel as in Claims 28 - 32
8 wherein the end product incorporates an antioxidant
9 containing two or more hydroxyl groups.

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11 34. A thermoplastic hydrogel as in Claim 33 wherein he
12 antioxidant may be internal or external.

13

14 35. A thermoplastic hydrogel as in Claims 33 and 34
15 wherein the antioxidant is ascorbic acid.

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17 36. A thermoplastic hydrogel as in Claims 33 and 34
18 wherein the antioxidant is 2,6-ditertiarybutyl4-
19 hyroxanisole.

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21 37. A thermoplastic hydrogel as in Claims 28 - 36
22 wherein the hydrogel develops opacity when swollen in
23 water.

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25 38. A thermoplastic hydrogel as in Claims 28 - 37
26 wherein the hydrogel incorporates dye(s).

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28 39. A thermoplastic hydrogel as in Claims 28 - 38
29 wherein the hydrogel incorporates pigment.

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31 40. A contact lens, prosthetic lens or cosmetic lens
32 produced from the hydrogel of Claims 28-39.